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POLLUTION OF DOMESTIC WATERS.

The question of how to protect domestic waters from pollution, is one of the most important and, at the same time, one of the most puzzling, questions that is brought before any board of health, state or local. The question is one that must be studied in its broadest sense, and in this study the principle of "the greatest good to the greatest number" must be thought of, but this saying must not be considered as meaning that the greatest number may endanger the health and lives of the few in order to avoid the expenditure of a reasonable amount of money in providing for the proper and sanitary disposal of their sewage. If any person, persons or corporation so disposes of sewage or other matter as to endanger the health or lives of others, such persons or corporation should be required to dispose of such matter in some manner so that this danger may be avoided. The laws of our state provide for this protection. One section of the public health law, Chapter 110, Session Laws of 1907, makes certain provisions along this line; but Chapter 177 of the same session makes most thorough provisions for the protection of the domestic waters of our state. This law is thorough and far reaching, and before its provisions may be rationally enforced a thorough study of conditions existing in our state must be made; the most practical methods of disposing of sewage in each section of the state must be studied; the appropriateness of the soil at various localities for filtration uses must be looked into; the effectiveness of various methods of disposing of sewage now in use in other states, with conditions similar to ours, must be studied; the cost of installation and maintenance of plants must be known; and all of this data must be brought together and compiled in such compact form that the board can positively state, at a moment's notice, that a certain method is the least expensive, the most practical and the most effectual method of disposing of the sewage in a given section of our state.

In the study of this subject, one of the first questions with which we are confronted is "What constitutes a potable, a safe, water for domestic purposes?" At first thought we answer "A water that shows certain results from chemical analysis." But is this true? If it were, the question would be greatly simplified. Chemical analysis will show evidences of sewage pollution to a certain degree, but with dilution to such an extent that chemical examination will no longer give evidence of pollution, the water may still be unsafe for chemical uses. While of great value in the study of this subject, chemical analysis alone will not prove that the water is safe for domestic uses any more than will the determination of color, odor and taste settle this question. The excreta from a single individual deposited in a stream of sufficient size to furnish the water supply for a town of 8,000 people would not be apparent in the least degree on chemical analysis, and yet there is a clear and well demonstrated instance in which the excreta from a single individual so polluted the waters of such a stream that an epidemic of typhoid fever, resulting in over 1,000 cases, was caused. The history of this epidemic will be related presently. Bacteriological examination will also assist in the determination of the purity of a water, in fact, a thorough bacteriological and chemical examination will determine very nearly the degree of purity of a water supply. But this examination must be very thorough. To test a single C. C. of water from a quart or gallon or five gallons leaves much room for doubt, but several such cultures should be made, anywhere from ten to fifty, and if after such examination there is no evidence of the presence of pathological germs we know—what? Simply that that particular sample of water is not polluted, but does it follow that the water was not polluted two hours after the sample was taken, especially if the stream or source from which the supply is received is the recipient of sewage? By no means, any stream into which sewage is emptied is liable to become contaminated with disease germs at any moment, and the only means by which a pure water supply can be assured is by the prevention of pollution, by seeing that all matter which may result in pollution of the waters of any stream in our state is disposed of in such a manner as to prevent such pollution.

Sources of Contamination.

Water supplies become polluted in three ways: surface drainage, seepage, and direct contamination.

In order that a water supply may become polluted it is not essential that the polluting matter be placed directly in the water; if it is placed near the water supply, on the banks or on the water-shed of a stream, so that it will be washed into the stream during the wet season, the pollution will be as effectually accomplished as if the polluting matter had been placed directly in the waters. This applies not only to human excreta but to barnyard filth and decomposing vegetable and animal matter. Hence the protection of a water supply includes the patroling of the water-shed from which the supply is secured.

Pollution by seepage is much more common than most are willing to admit. Spring water is supposed to be pure water, but every little rivulet springing out of the ground is not a true spring, it may come from a water closet or cess-pool only a few feet distant, or it may come some distance through a channel in the ground and no filtration result. Whether water coming out of the ground (we will call it spring water) is pure or not depends on the character of the soil through which it has passed. Water which has passed through a porous soil of sufficient thickness and of proper density is a pure water but water that has simply passed through a calcarious deposit, and has cut little channels for itself, is not a pure water, unless it was pure before it entered such deposit. In many parts of our state it is only a short distance from the surface to a strata of gravel, often of a broken cement character, through which sewage may pass with no more filtration than in an open ditch, indeed it is protected from the action of light on the disease germs and putrification may be added to its other undesirable constituents. It is customary to construct a cesspool so that it will enter this strata and the so-called seepage therefrom is no seepage at all, but simply a form of natural sewer, opening at some more or less distant point in the form of a so-called "spring." But the cesspool not only forms these "sewer springs" but is also a danger to those nearest to it. In this vile hole, decomposition goes on and foul gases are formed. The thing is tightly sealed and the gas escapes through the ground to the nearest outlet. This is naturally the cellar of the house. This gas has not been shown to contain disease germs, but it has been repeatedly demonstrated that it has a devitalizing effect on those who breath it, and thus predisposes them to any communicaple disease with which they may come in contact. Hence the protection of a water supply requires that cesspools and water closets shall be properly constructed.

Direct sewage contamination, in the light of recent researches, would seem to be a self-condemned practice, and yet it is one of the most difficult propositions that comes before us. This difficulty arises partly from the disposition on the part of persons or corporations to resent any action that may necessitate the expenditure of a dollar, and partly from the lack of care on the part of some health officers in giving advise to their boards of health. This is well illustrated from the following statement in a letter recently received. "If, as authorities agree, a river purifies itself every two or three miles, what is the objection to permitting butchers putting the offal from slaughter houses into the river?" "If, as authorities agree." What authorities? Is the work of the Massachusetts board of health along this line, extending over twenty years, to count for nothing? Is the opinion of such men as Mason, Pratt, the Ohio board of health, and any number of men of such standing, who are devoting their lives to this very line of work, to count for nothing? Is the opinion of the English sanitary committee, especially appointed to study this question, to count for nothing? Who then is the authority, none of the men or combinations of men mentioned above advancing any such idea?

How much sewage can a stream of a given size stand without showing pollution? This is a very broad question and would tickle the fancy of a lawyer propounding a hypothetical question. It is equivalent to asking "how much of a solution of a poison can an individual drink and not be killed," without mentioning the nature of the poison or the strength of the solution. Following the ideas advanced by the authorities mentioned above, and others, it is generally admitted that if a stream has a flow of from four to six cubic feet per second the sewage from 1,000 persons will not cause a nuisance apparent to sight and smell. But this is not to be construed as suggesting that such water will be safe for dometic uses; it pertains only to a nuisance apparent to the senses mentioned. The influence of sewage on a stream depends on the character of the sewage, what it contains. If a sewage contains no disease germs its effect will be rapidly eradicated, but it is impossible to tell when the sewage from any town or from a single residence will contain typhoid germs and in the study of this subject we must assume that all sewage contains these germs. I mention typhoid germs, as this is practically the only waterborn disease with which we have to contend in Montana at present.

The influence of sewage on waters in our state has not been studied, and we must therefore take the results derived from such study in other states, under similar conditions. First, what is the influence of sewage contamination on large streams? Let us take the Hudson river as an example, as we desire to give the streams of our state every advantage and take as example a stream of larger volume than any in our state. In July, 1890, an epidemic of typhoid appeared at Schenectady, on the Mohawk river, a tributary of the Hudson. The sewage from Schenectady had been emptied into the Mohawk, for many years, and yet the people of Albany, 23 miles below, on the Hudson, taking their water from the Hudson, did not consider that their water was polluted, depending on the "self purification of the river" for protection. Nevertheless the epidemic at Schenectady was promptly followed by an epidemic at Albany, which was traced directly to the infection of the river water. It is not expedient to burden you at this time with the extensive evidence which has been published to prove that the epidemic at Albany originated from the infection of the water at Schenectady, suffice it to say that the evidence is complete and conclusive, and those who desire to do so can read this evidence in "Mason on Water Supply" and other similar works. These same works go on to show that the sewage from Schenectady, and several other small towns, especially Waterford, Troy, West Troy, Cohoes and Lansingburg, all emptied sewage into the Hudson and yet the river at Albany showed no chemical evidence of sewage pollution, but as soon as typhoid germs are introduced at Schenectady they very promptly make their appearance at Albany and cause an epidemic. If a stream the size of the Hudson can not be depended on to purify the waters from the effect of typhoid contaminated sewage from a town of 20,000 within a distance of 23 miles, what can be expected from any stream in our state under similar conditions?

Some of you will say, "Our streams differ radically from the Hudson in the character of the flow, and that the rapid turning over of the water will result in immediate purification," etc. Let us see what happens in mountain streams, as shown by one of, if not the most carefully studied epidemic of history. During the winter of 1884-5 the town of Plymoth, Pa., a town of 8,000 people, was visited by an epidemic of typhoid fever of 1,000 cases with 100 deaths. The facts sifted and tested by expert scientific methods are as follows: The general water supply of Plymoth is obtained from a mountain brook, a number of dams being thrown across the stream for this purpose. During part of the winter of 1884-5, owing to the deep freezing of the stream, the hydrant water was taken from the neighboring river, the Susquehanna. There are very few houses on the banks of the mountain brook, and it would seem that the stream is unusually well protected from sources of contamination. During the time that the stream was frozen a man came from Philadelphia, ill with typhoid fever. He had contracted the disease at a place from which three other persons, ill with typhoid fever, had been removed to hospitals. This man was cared for in a house near the source of the mountain stream, or at least considerably above where the city water supply was secured. The discharge from the bowels of the sick man were not disinfected. They were thrown, by the nurse, on the deep snow on the sidehill, sloping towards the stream, which was not over forty feet distant. A sudden rise in temperature towards the close of March caused a general thaw, and the melted snow on the hillside, with the mass of typhoid poison, was swept into the stream. At just this time, owing to the rise of water in the brook, the Susquehanna river water was shut off from the mains and that of the brook turned in again. Within two or three weeks hundreds of cases of typhoid fever developed, and these cases were, without exception, confined to those using th water from the brook, while those using water from other sources were not infected.

This is the influence of the excreta from a single person suffering from typhoid fever on a stream similar to the streams in our state. However, the water had traveled only a short distance and the question, "What would have been the result had the excreta been placed in the stream fifteen or twenty miles above the intake?" is fairly asked.

The natural life of the typhoid fever germ in water is from 25 to 30 days. Certain conditions influence the longevity of the germ, and the more pure the water the longer will they live, but the average life is from 25 to 30 days. Freezing does not kill them and the rapidity with which the stream flows does not influence their longevity. Direct sunlight is most destructive to these germs, but it must be remembered that the influence of direct sunlight extends but little below the surface of the water, so that we can not look for much benefit from this source in streams of sufficient size to carry the sewage from a single household without causing a public nuisance. Thus we conclude that a stream infected with typhoid fever germs will remain infected as long as the germs live and that the infection will extend as far as the stream will flow in from 25 to 30 days and there is not a stream in Montana the waters of which will not have passed the borders of the state within 25 days.

I have mentioned only two instances of infected waters from typhoid germs. These instances can be multiplied hundreds of times, but the two instances mentioned were studied most thoroughly and are classical cases.

All evidence indicates that a stream will purify itself only in the sense that the evidence of sewage pollution will be destroyed by oxidization and nitrification, but that it will not purify itself in the least degree in the sense of freeing itself from diseased germs, hence the expression "no river is long enough to purify itself" and as any sewage is liable at any time to contain typhoid germs, no sewage bearing water is a safe water for domestic purposes.

The only water supply that can be depended on as a safe source of domestic water is a supply that receives no sewage contamination and the placing of sewage in any stream in Montana endangers the health and lives of those who depend on the waters of such stream for domestic purposes. Self purification of streams has been disproven beyond question and the only method by which a safe supply of water for domestic purposes can be assured is by the protection of our streams from pollution.

COMMUNICABLE DISEASES REPORTED FOR THE MONTH OF APRIL, 1908.

SMALLPOX—Cases of smallpox were reported as follows: Broadwater 1; Carbon 1; Chouteau 17; Custer 7; Dawson 1; Fergus 1; Flathead 2; Gallatin 4 (1 in Bozeman); Granite 1; Lewis and Clark 3 (in Helena); Missoula 50 (43 in Missoula City); Ravalli 11; Sanders 3; Silver Bow 8; total 110; total last month 82; total last April 23.

DIPHTHERIA—Cases of diphtheria were reported as follows: Beaverhead 1; Carbon 2; Cascade 9 (8 in Great Falls); Chouteau 2; Custer 12; Dawson 4; Deer Lodge 1 (in Anaconda); Flathead 5; Gallatin 1 (in Bozeman); Granite 4; Jefferson 3; Lewis and Clark 2; Madison 1; Missoula 14 (9 in Missoula City); Park 1 (in Livingston); Powell 4; Rosebud 1; Sanders 1; Silver Bow 23 (17 in Butte); Valley 1; Yellowstone 16 (12 in Billings); total 108; total last month 79; total last April 69.

SCARLATINA—Cases of scarlet fever were reported as follows: Beaverhead 22; Broadwater 1; Cascade 14 (5 in Great Falls); Deer Lodge 1 (in Anaconda); Flathead 5; Gallatin 19; Lewis and Clark 7 (6 in Helena); Madison 18; Missoula 28 21 in Missoula City); Park 1; Ravalli 3; Silver Bow 35 (29 in Butte); Sweetgrass 1; Yellowstone 4 (in Billings); total 159; total last month 99; total last April 16.

MEASLES—Cases of measles were reported as follows: Carbon 1; Cascade 1 (in Great Falls); Chouteau 5; Custer 2; Dawson 4; Fergus 1; Flathead 36; Lewis and Clark 2 (1 in Helena); Missoula 8 (in Missoula City); Park 7 (in Livingston); Sanders 1; Silver Bow 20 (7 in Butte); Yellowstone 8 (7 in Billings); total 96; total last month 92; total last April 66.

TYPHOID FEVER—Cases of typhoid fever were reported as follows: Beaverhead 1; Cascade 4 (Great Falls 2); Chouteau 1; Gallatin 1; Jefferson 1; Powell 1; Rosebud 1; total 10; total last month 17; total last April 10.

BIRTHS.

Births reported to the State Board of Health of Montana for April 1908, and comparative birth and death rate in State.

	Males	Females	Totals	Deaths	Excess of Births	Excess of Deaths		Males	Females	Totals	Deaths	Excess of Births	Excess of Deaths
Beaverhead	10	3	13	9	4	....	Meagher	2		2	1	1	....
Broadwater	3	1	4	4	....	....	Missoula	15	13	28	33	....	5
Carbon	10	16	26	11	15	....	Park	14	12	26	11	15	....
Cascade	21	21	42	27	15	....	Powell	1	3	4	10	....	6
Choteau	3	5	8	4	4	....	Ravalli	6	8	14	10	4	....
Custer	3	8	11	7	4	....	Rosebud	3	3	6	2	4	....
Dawson	6	2	8	6	2	....	Sanders		1	1	1	0	....
Deer Lodge	10	12	22	25	....	3	Silver Bow	36	38	74	94		20
Fergus	3	9	12	8	4	....	Sweetgrass	4	1	5	2	3	....
Flathead	22	11	33	21	12	....	Teton	4	2	6	1	5	....
Gallatin	8	9	17	11	6	....	Valley	5	5	10	3	7	....
Granite	1	2	3	2	1	....	Yellowstone	12	18	30	26	4	....
Jefferson	7	5	12	5	7	....							
Lewis and Clark	13	16	29	26	3	....	Totals	228	229	457	375	82	38
Madison	6	5	11	15	....	4							

Births reported from Cities of 5,000 or more inhabitants.

Anaconda	10	12	22	16	6	....	Great Falls	15	18	33	18	15	....
Billings	9	14	23	20	3	....	Helena	12	14	26	20	6	....
Bozeman	5	3	8	8	....	....	Livingston	6	6	12	9	3	....
Butte	36	38	74	56	18	....	Missoula	12	9	21	22		1

MORTALITY

Deaths Reported to the State Board of Health for the Month of April 1908, Arranged According to Counties,

	Tuberculosis	Diphtheria	Scarlet Fever	Measels	Typhoid Fever	Meningitis	Whooping-Cough	Pneumonia	Nephritis	Organic Heart Disease	Malignant Tumors	Acute Intestinal Diseases	Violence	Suicide	Alcoholism	All other Causes	Totals
Beaverhead	1	....	....	....	....	....	....	....	2	2	1	....	....	....	1	2	9
Broadwater	....	....	....	....	....	....	....	1	1	1	....	....	....	....	....	1	4
Carbon	....	....	....	....	....	2	....	2	....	3	....	....	....	....	....	4	11
Cascade	2	....	....	....	1	....	1	1	2	3	....	....	1	2	....	14	27
Chouteau	....	....	....	....	....	....	....	....	....	....	....	....	2	....	1	1	4
Custer	....	....	....	....	....	....	....	3	....	1	....	....	1	....	1	1	7
Dawson	1	....	....	....	....	....	....	....	1	....	....	....	2	1	....	1	6
Deer Lodge	....	....	....	....	....	1	....	4	1	1	....	....	2	....	....	16	25
Fergus	....	....	....	....	....	1	....	....	....	....	....	1	....	2	....	4	8
Flathead	1	....	....	....	....	1	....	....	....	3	1	....	4	....	....	11	21
Gallatin	....	....	....	....	....	3	....	1	....	....	....	1	1	....	....	5	11
Granite	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	2
Jefferson	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	4	5
Lewis and Clark	4	1	....	....	....	....	....	5	2	1	....	....	1	....	....	12	26
Madison	....	....	1	....	....	....	....	1	....	....	....	1	5	....	....	7	15
Meagher	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Missoula	4	1	....	....	....	....	....	7	1	1	....	....	4	1	....	14	33
Park	1	....	....	....	....	....	....	....	....	....	....	....	3	....	....	7	11
Powell	....	....	....	....	2	....	....	2	....	....	....	....	3	....	....	3	10
Ravalli	....	....	....	....	....	....	1	2	....	2	....	....	....	....	....	5	10
Rosebud	....	....	....	....		....	....	....	....	....	....	....	1	....	....	1	2
Sanders	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Silver Bow	4	....	4	....	....	7	....	21	....	3	1	1	3	....	2	48	94
Sweet Grass	1	....	....	....	....	....	....	1	....	....	....	..	....	....	....	....	2
Teton	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Valley	....	.	....	....	....	....	....	....	....	....	....	....	....	1	....	2	3
Yellowstone	1	1	1	1	....	....	1	4	1	2	....	1	1	1	....	11	26
Totals	20	3	6	1	3	15	3	56	11	23	3	5	35	8	5	178	375

Deaths per 100,000; 133.92

Annual Death rate per 1,000; 16.07

Deaths reported from cities of 5,000 or more inhabitants

Anaconda	....	....	....	....	....	1	....	4	1	1	....	....	2	....	....	7	16
Billings	1	1	1	....	....	....	1	4	1	2	....	....	1	1	....	7	20
Bozeman	....	....	....	....	....	3	....	1	....	....	....	....	....	....	....	4	8
Butte	3	....	3	....	....	2	....	10	2	2	1	....	2	....	1	30	56
Great Falls	2	....	....	....	1	....	....	1	2	2	....	....	1	2	....	7	18
Helena	4	1	....	....	....	....	....	4	2	1	....	....	....	....	....	8	20
Livingston	1	....	....	....	....	....	....	....	....	....	....	....	2	....	....	6	9
Missoula	2	....	....	....	....	....	....	6	....	1	....	....	1	1	....	11	22